

# Rule 21 Model Rule – As of 9/15/04

## A. APPLICABILITY

**Applicability.** This Rule describes the Interconnection, operating and Metering requirements for Generating Facilities to be connected to Electric Corporation's (EC) Distribution System over which the California Public Utilities Commission (Commission) has jurisdiction. Subject to the requirements of this Rule, EC will allow the Interconnection of Generating Facilities with its Distribution System.

**Definitions.** Capitalized terms used in this Rule, and not defined in EC's other tariffs, shall have the meaning ascribed to such terms in Section H of this Rule. The definitions set forth in Section H of this Rule shall only apply to this Rule and may not apply to EC's other tariffs.

**Consistent with IEEE 1547:** This rule has been revised to be consistent with the requirements of ANSI/IEEE<sup>1</sup> 1547-2003 *Standard for Interconnecting Distributed Resources with Electric Power Systems* (IEEE 1547). In some cases, IEEE 1547 language has been adopted directly, in others, IEEE 1547 requirements were interpreted and this rule's language was changed to maintain the spirit of both documents.

Language from IEEE 1547 that has been adopted directly (as opposed to paraphrased language or previous language that was determined to be consistent with IEEE 1547) is followed by a citation that lists the Clause from which the language derived. For example, IEEE 1547-4.1.1 is a reference to Clause 4.1.1.

In the event of any conflict between this rule and any of the standards listed herein, the requirements of this rule shall take precedence.

## B. GENERAL RULES, RIGHTS AND OBLIGATIONS

- B.1. AUTHORIZATION REQUIRED TO OPERATE.** A Producer must comply with this Rule, execute an Interconnection Agreement with EC, and receive EC's express written permission before Parallel Operation of its Generating Facility with EC's Distribution System. EC shall apply this Rule in a non-discriminatory manner and shall not unreasonably withhold its permission for Parallel Operation of Producer's Generating Facility with EC's Distribution System.
- B.2. SEPARATE AGREEMENTS REQUIRED FOR OTHER SERVICES.** A Producer requiring other electric services from EC including, but not limited to, Distribution Service during periods of curtailment or interruption of the Producer's Generating Facility, enter into agreements with EC for such services in accordance with EC's Commission-approved tariffs.
- B.3. SERVICE NOT PROVIDED WITH INTERCONNECTION.** Interconnection with EC's Distribution System under this Rule does not provide a Producer any rights to utilize EC's System for the transmission, distribution, or wheeling of electric power, nor does it limit those rights.
- B.4. COMPLIANCE WITH LAWS, RULES AND TARIFF SCHEDULES.** A Producer shall ascertain and comply with applicable Commission-approved tariffs of EC; applicable Federal Energy Regulatory Commission (FERC) approved rules, tariffs and regulations; and any local, state or federal law, statute or regulation which applies to the design,

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<sup>1</sup> ANSI – American National Standards Institute; IEEE – Institute of Electrical and Electronic Engineers

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siting, construction, installation, operation, or any other aspect of the Producer's Generating Facility and Interconnection Facilities.

- B.5. DESIGN REVIEWS AND INSPECTIONS.** EC shall have the right to review the design of a Producer's Generating and/or Interconnection Facilities and to inspect a Producer's Generating and/or Interconnection Facilities prior to the commencement of Parallel Operation with EC's Distribution System. EC may require a Producer to make modifications as necessary to comply with the requirements of this Rule. EC's review and authorization for Parallel Operation shall not be construed as confirming or endorsing the Producer's design or as warranting the Generating and/or Interconnection Facilities' safety, durability or reliability. EC shall not, by reason of such review or lack of review, be responsible for the strength, adequacy or capacity of such equipment.
- B.6. RIGHT TO ACCESS.** A Producer's Generating Facility and/or Interconnection Facilities shall be reasonably accessible to EC personnel as necessary for EC to perform its duties and exercise its rights under its tariffs approved by the Commission, and any Interconnection Agreement between EC and the Producer.
- B.7. CONFIDENTIALITY OF INFORMATION.** Any information pertaining to Generating and/or Interconnection Facilities provided to EC by a Producer shall be treated by EC in a confidential manner. EC shall not use information contained in the Application to propose discounted tariffs to the customer unless authorized to do so by the Customer or the information is provided to EC by the Customer through other means.
- B.8. PRUDENT OPERATION AND MAINTENANCE REQUIRED.** A Producer shall operate and maintain its Generating Facility and Interconnection Facilities in accordance with Prudent Electrical Practices and shall maintain compliance with this Rule.
- B.9. CURTAILMENT AND DISCONNECTION.** EC may limit the operation or disconnect or require the disconnection of a Producer's Generating Facility from EC's Distribution System at any time, with or without notice, in the event of an Emergency, or to correct Unsafe Operating Conditions. EC may also limit the operation or disconnect or require the disconnection of a Producer's Generating Facility from EC's Distribution System upon the provision of reasonable written notice: 1) to allow for routine maintenance, repairs or modifications to EC's Distribution System; 2) upon EC's determination that a Producer's Generating Facility is not in compliance with this Rule; or 3) upon termination of the Interconnection Agreement. Upon the Producer's written request, EC shall provide a written explanation of the reason for such curtailment or disconnection.

### C. APPLICATION AND INTERCONNECTION PROCESS

#### C.1. APPLICATION PROCESS

- C.1.a. Applicant Initiates Contact With EC.** Upon request, EC will provide information and documents (such as sample agreements, Application, technical information, listing of Certified Equipment, Initial and Supplemental Review fee information, applicable tariff schedules and Metering requirements) to a potential Applicant. Unless otherwise agreed upon, all such information shall normally be sent to an Applicant within three (3) business days following the initial request from the Applicant. EC will establish an individual representative as the single point of

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contact for the Applicant, but may allocate responsibilities among its staff to best coordinate the Interconnection of an Applicant's Generating Facility.

**C.1.b. Applicant Completes an Application.** All Applicants shall complete and file an Application and supply any relevant additional information requested by EC. When applicable per Table C.1, an \$800 Initial Review fee shall be included with the Application.

- 1) Normally, within 10 business days of receiving the Application, EC shall acknowledge its receipt and state whether the Application has been completed adequately. If defects are noted, EC and Applicant shall cooperate in a timely manner to establish a satisfactory Application.
- 2) The Initial Review fee shall be waived for Applications requesting Interconnection pursuant to Sections 2827, 2827.8, 2827.9, or 2827.10 of the Public Utilities Code, and for Solar powered Generating Facilities that do not sell power to the grid per Commission Decision D.01-07-027.
- 3) Fifty percent of the fees associated with the Initial Review will be returned to the Applicant if the Application is rejected by EC or the Applicant retracts the Application.
- 4) Applications that are over one year old (from the date of EC's acknowledgement) without a signed Interconnection Agreement, or a Generating Facility that has not been approved for parallel operation within one year of completion of all applicable review and/or studies are subject to cancellation by EC; however, EC may not cancel an Application if the Producer provides reasonable evidence that the project is still active.
- 5) The applicant may propose, and the EC may agree to reduced costs for reviewing atypical Applications, such as Applications submitted for multiple Generators, multiple sites, or otherwise as conditions warrant

**C.1.c. EC Performs an Initial and Supplemental Review and Develops Preliminary Cost Estimates and Interconnection Requirements.**

- 1) Upon receipt of a satisfactorily completed Application and any additional information necessary to evaluate the Interconnection of a Generating Facility, EC shall perform an Initial Review using the process defined in Section I. The Initial Review determines if: (a) the Generating Facility qualifies for Simplified Interconnection; or (b) the Generating Facility requires a Supplemental Review.
- 2) EC shall complete its Initial Review, absent any extraordinary circumstances, within 10 business days after its determination that the Application is complete. If the Initial Review determines the proposed Generating Facility can be Interconnected by means of a Simplified Interconnection, EC will provide the Applicant with an Interconnection Agreement for Applicant's signature.
- 3) If the Generating Facility does not pass the Initial Review for Simplified Interconnection as proposed, EC will notify the applicant and perform a Supplemental Review as described in Section I., Applicant shall pay an additional \$600 for the Supplemental Review, unless the Application is withdrawn. The

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Supplemental Review will result in EC providing either: (a) Interconnection requirements beyond those for a Simplified Interconnection, and an Interconnection Agreement for Applicant's signature; or (b) a cost estimate and schedule for an Interconnection Study. The Supplemental Review shall be completed, absent any extraordinary circumstances, within 20 business days of receipt of a completed Application and fees. .

The Supplemental Review fee shall be waived for Applications requesting Interconnection pursuant to Sections 2827, 2827.8, 2827.9, or 2827.10 of the Public Utilities Code, and for Solar powered Generating Facilities that do not sell power to the grid, per Commission Decision D.01-07-027

**C.1.d. When Required, Applicant and EC Commit to Additional Interconnection Study Steps.** When a Supplemental Review reveals that the proposed Generating Facility cannot be Interconnected to EC's Distribution System by means of a Simplified Interconnection, or that significant Interconnection Facilities installed on EC's system or Distribution System modifications will be needed to accommodate an Applicant's Generating Facility, EC and Applicant shall enter into an agreement that provides for EC to perform additional studies, facility design, and engineering and to provide detailed cost estimates for fixed price or actual cost billing to the Applicant at the Applicant's expense. The Interconnection Study agreement shall set forth EC's estimated schedule and charges for completing such work. Interconnection Study fees for solar generating facilities up to 1 megawatt (MW) that do not sell power to the grid will be waived up to the amount of \$5,000. Generating Facilities eligible for Net Energy Metering under Public Utilities Code Section 2827, 2827.8, 2827.9, or 2827.10 are exempt from any costs associated with Interconnection Studies.

Table C.1 Summary of Fees and Exemptions

Generating Facility Type	Initial Review Fee	Supplemental Review Fee	Interconnection Study Fees
Non-Net Energy Metering	\$800*	\$600	As Specified by EC
Net Energy Metering (per Public Utilities Code Sections 2827, 2827.8, 2827.9, or 2827.10)	\$0	\$0	\$0
Solar 1MW or less that does not sell power to the grid (per D.01-07-027)	First \$5,000 of study fees waived		

\*Subject to 50% refund pursuant to Section C.1.b.3

### C.2. INTERCONNECTION PROCESS

**C.2.a. Applicant and EC Enter Into an Interconnection Agreement and, Where Required, a Financing and Ownership Agreement for Interconnection Facilities or Distribution System Modifications.** EC shall provide the Applicant with an executable version of the Interconnection Agreement or Net Energy Metering agreement appropriate for the Applicant's Generating Facility and desired mode of operation. Where the Supplemental Review or Interconnection Study

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performed by EC has determined that modifications or additions to its Distribution System are required, or that additional Interconnection Facilities will be necessary to accommodate an Applicant's Generating Facility, EC may also provide the Applicant with other Interconnection Facilities financing and ownership agreements. These agreements shall set forth EC and the Applicant's responsibilities, completion schedules, and fixed price or estimated costs for the required work.

**C.2.b. Where Applicable, EC or Producer Installs Required Interconnection Facilities or Modifies EC's Distribution System.** After executing the applicable agreements, EC or Producer will commence construction/ installation of EC's Distribution System modifications or Interconnection Facilities which have been identified in the agreements. The parties will use good faith efforts to meet schedules and estimated costs as appropriate.

**C.2.c. Producer Arranges for and Completes Commissioning Testing of Generating Facility and Producer's Interconnection Facilities.** The Producer is responsible for testing new Generating Facilities and associated Interconnection Facilities according to Section J.5 to ensure compliance with the safety and reliability provisions of this Rule prior to being operated in parallel with EC's Distribution System. For non-Certified Equipment, the Producer shall develop a written testing plan to be submitted to EC for its review and acceptance. Alternatively, the Producer and EC may agree to have EC conduct the required testing at the Producer's expense. Where applicable, the test plan shall include the installation test procedures published by the manufacturer of the generation or Interconnection equipment. Facility testing shall be conducted at a mutually agreeable time, and depending on who conducts the test, EC or Producer shall be given the opportunity to witness the tests.

**C.2.d. EC Authorizes Parallel Operation or Momentary Parallel Operation.** EC shall authorize the Producer's Generating Facility for Parallel Operation or Momentary Parallel Operation with EC's Distribution System, in writing, within 5 calendar days of satisfactory compliance with the terms of all applicable agreements. Compliance may include, but not be limited to, provision of any required documentation and satisfactorily completing any required inspections or tests as described herein or in the agreements formed between the Producer and EC. A Producer shall not commence Parallel Operation of its Generating Facility with EC's system unless it has received EC's express written permission to do so.

For Generating Facilities qualifying for service under Public Utilities Code Sections 2827 and 2827.8, EC authorization for Parallel Operation shall normally be provided no later than 30 business days following EC's receipt of 1) a completed Net Energy Metering Application including all supporting documents and required payments; 2) a completed signed Net Energy Metering Interconnection Agreement; and 3) evidence of the Producer's final inspection clearance from the governmental authority having jurisdiction over the Generating Facility. If the 30-day period cannot be met, the EC shall notify the Applicant and the Commission.

### D. GENERATING FACILITY DESIGN AND OPERATING REQUIREMENTS

This section has been revised to be consistent with the requirements of ANSI/IEEE 1547-2003 *Standard for Interconnecting Distributed Resources with Electric Power Systems* (IEEE 1547).

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Exceptions are taken to IEEE 1547 Clauses 4.1.4.2 Distribution Secondary Spot Networks and Clauses 4.1.8.1 or 5.1.3.1, which address Protection from Electromagnetic Interference. These are being studied for inclusion in a subsequent version of this rule. Also, Rule 21 does not adopt the Generating Facility power limitation of 10 MW incorporated in IEEE 1547.

### D.1 General Interconnection and Protective Function Requirements

The Protective Functions and requirements of this rule are designed to protect EC's Distribution System and not the Generating Facility. A Producer shall be solely responsible for providing adequate protection for its Generating Facility and Interconnection Facilities. The Producer's Protective Functions shall not impact the operation of other Protective Functions utilized on EC's Distribution System in a manner that would affect EC's capability of providing reliable service to its Customers.

**D.1.a. Protective Functions Required.** Generating Facilities operating in parallel with EC's Distribution System shall be equipped with the following Protective Functions to sense abnormal conditions on EC's Distribution System and cause the Generating Facility to be automatically disconnected from EC's Distribution System or to prevent the Generating Facility from being connected to EC's Distribution System inappropriately:

- 1) Over and under voltage trip functions and over and under frequency trip functions;
- 2) A voltage and frequency sensing and time-delay function to prevent the Generating Facility from energizing a de-energized Distribution System circuit and to prevent the Generating Facility from reconnecting with EC's Distribution System unless EC's Distribution System service voltage and frequency is within the ANSI C84.1-1995 Table 1 Range B Voltage Range of 106V to 127V (on a 120V basis), inclusive, and a frequency range of 59.7 Hz to 60.5 Hz, inclusive, and are stable for at least 60 seconds; and
- 3) A function to prevent the Generating Facility from contributing to the formation of an Unintended Island, and cease to energize the EC's Distribution System within two seconds of the formation of an Unintended Island.

The Generating Facility shall cease to energize EC's Distribution System for faults on EC's Distribution System circuit to which it is connected (IEEE1547-4.2.1). The Generating Facility shall cease to energize EC's Distribution circuit prior to re-closure by EC's Distribution System equipment (IEEE1547-4.2.2).

**D.1.b. Momentary Paralleling Generating Facilities.** With EC's approval, the transfer switch or scheme used to transfer the Producer's loads from EC's Distribution System to Producer's Generating Facility may be used in lieu of the Protective Functions required for Parallel Operation.

**D.1.c. Suitable Equipment Required.** Circuit breakers or other interrupting equipment located at the Point of Common Coupling must be Certified or "Listed" (as defined in Article 100, the Definitions Section of the National Electrical Code) as suitable for their intended application. This includes being capable of interrupting the maximum available fault current expected at their location. Producer's Generating Facility and Interconnection Facilities shall be designed so that the failure of any

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single device or component shall not potentially compromise the safety and reliability of EC's Distribution System. The Generating Facility paralleling-device shall be capable of withstanding 220% of the Interconnection Facility rated voltage (IEEE1547-4.1.8.3). The Interconnection Facility shall have the capability to withstand voltage and current surges in accordance with the environments defined in IEEE Std C62.41.2-2002 or IEEE Std C37.90.1-2002 as applicable and as described in J.3.e (IEEE1547-4.1.8.2).

**D.1.d. Visible Disconnect Required.** When required by EC's operating practices, the Producer shall furnish and install a ganged, manually-operated isolating switch (or a comparable device mutually agreed upon by EC and the Producer) near the Point of Interconnection to isolate the Generating Facility from EC's Distribution System. The device does not have to be rated for load break nor provide over-current protection.

The device must:

- 1) allow visible verification that separation has been accomplished. (This requirement may be met by opening the enclosure to observe contact separation.)
- 2) include markings or signage that clearly indicate open and closed positions.
- 3) be capable of being reached quickly and conveniently 24 hours a day by EC personnel for construction, operation, maintenance, inspection, testing or reading, without obstacles or requiring those seeking access to obtain keys, special permission, or security clearances.
- 4) be capable of being locked in the open position.
- 5) be clearly marked on the submitted single line diagram and its type and location approved by the EC prior to installation. If the device is not adjacent to the PCC, permanent signage must be installed at an EC-approved location providing a clear description of the location of the device.

Generating Facilities with Non-Islanding inverters totaling one (1) kilovolt-ampere (kVA) or less are exempt from this requirement.

**D.1.e. Drawings Required.** Prior to Parallel Operation or Momentary Parallel Operation of the Generating Facility, EC shall approve the Producer's Protective Function and control diagrams. Generating Facilities equipped with Protective Functions and a control scheme previously approved by EC for system-wide application or only Certified Equipment may satisfy this requirement by reference to previously approved drawings and diagrams.

**D.1.f. Generating Facility Conditions Not Identified.** In the event this Rule does not address the Interconnection conditions for a particular Generating Facility, EC and Producer may agree upon other arrangements.

### D.2. PREVENTION OF INTERFERENCE

The Producer shall not operate Generating or Interconnection Facilities that superimpose a voltage or current upon EC's Distribution System that interferes with EC operations, service to

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EC customers, or communication facilities. If such interference occurs, the Producer must diligently pursue and take corrective action at its own expense after being given notice and reasonable time to do so by EC. If the Producer does not take corrective action in a timely manner, or continues to operate the facilities causing interference without restriction or limit, EC may, without liability, disconnect the Producer's facilities from EC's Distribution System, in accordance with Section B.9 of this Rule. To eliminate undesirable interference caused by its operation, each Generating Facility shall meet the following criteria:

- D.2.a. Voltage Regulation.** The GF shall not actively regulate the voltage at the PCC while in parallel with EC's Distribution System. The GF shall not cause the service voltage at other customers to go outside the requirements of ANSI C84.1-1995, Range A (IEEE1547-4.1.1).
- D.2.b. Operating Voltage Range.** The voltage ranges in Table D.1 define protective trip limits for the Protective Function and are not intended to define or imply a voltage regulation Function. Generating Facilities shall cease to energize EC's Distribution System within the prescribed trip time whenever the voltage at the Point of Common Coupling deviates from the allowable voltage operating range.. The Protective Function shall detect and respond to voltage on all phases to which the Generating Facility is connected.
- 1) Generating Facilities (30 kVA or less).** Generating Facilities with a Gross Nameplate Rating of 30 kVA or less shall be capable of operating within the voltage range normally experienced on EC's Distribution System. The operating range shall be selected in a manner that minimizes nuisance tripping between 106 volts and 132 volts on a 120-volt base (88%-110% of nominal voltage). Voltage shall be detected at either the PCC or the Point of Interconnection.
  - 2) Generating Facilities (greater than 30 kVA).** EC may have specific operating voltage ranges for Generating Facilities with Gross Nameplate Ratings greater than 30 kVA, and may require adjustable operating voltage settings. In the absence of such requirements, the Generating Facility shall operate at a range between 88% and 110% of the applicable interconnection voltage. Voltage shall be detected at either the PCC or the Point of Interconnection, with settings compensated to account for the voltage at the PCC, Generating Facilities that are Certified Non-Islanding or that meet one of the options of the Export Screen (Section I.3.b) may detect voltage at the Point of Interconnection without compensation.
  - 3) Voltage Disturbances.** Whenever EC's Distribution System voltage at the Point of Common Coupling varies from and remains outside normal (nominally 120 volts) for the predetermined parameters set forth in Table D-1, the Generating Facility's Protective Functions shall cause the Generator(s) to become isolated from EC's Distribution System:



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Table D.1: Voltage Trip Settings

Voltage at Point of Common Coupling		Maximum Trip Time [1]	
Assuming 120 V Base	% of Nominal Voltage	# of Cycles (Assuming 60Hz Nominal )	Seconds
Less than 60 Volts	Less than 50%	10 Cycles	0.16 Seconds
Greater than or equal to 60 Volts but less than 106 Volts	Greater than or equal to 50% but less than 88%	120 Cycles	2 Seconds
Greater than or equal to 106 Volts but less than or equal to 132 Volts	Greater than or equal to 88% but less than or equal to 110%	Normal Operation	
Greater than 132 Volts but less than or equal to 144 Volts	Greater than 110% but less than or equal to 120%	60 Cycles	1 Second
Greater than 144 Volts	Greater than 120%	10 Cycles	0.16 Seconds

[1] - "Maximum Trip time" refers to the time between the onset of the abnormal condition and the Generating Facility ceasing to energize EC's Distribution System. Protective Function sensing equipment and circuits may remain connected to EC's Distribution System to allow sensing of electrical conditions for use by the "reconnect" feature. The purpose of the allowed time delay is to allow a Generating Facility to "ride through" short-term disturbances to avoid nuisance tripping. Set points shall not be user adjustable (though they may be field adjustable by qualified personnel). For Generating Facilities with a Gross Nameplate Rating greater than 30 kVA, set points shall be field adjustable and different voltage set points and trip times from those in Table D.1 may be negotiated with EC.

**D.2.c. Paralleling.** The Generating Facility shall parallel with EC's Distribution System without causing a voltage fluctuation at the PCC greater than  $\pm 5\%$  of the prevailing voltage level of EC's Distribution System at the PCC, and meet the flicker requirements of Section D.2.d. Section J provides technology-specific tests for evaluating the paralleling Function. (IEEE1547-4.1.3)

**D.2.d. Flicker.** The Generating Facility shall not create objectionable flicker for other customers on EC's Distribution System. To minimize the adverse voltage effects experienced by other customers (IEEE1547-4.3.2), flicker at the Point of Common Coupling caused by the Generating Facility should not exceed the limits defined by the "Maximum Borderline of Irritation Curve" identified in IEEE 519-1992 (IEEE Recommended Practices and Requirements for Harmonic Control in Electric Power Systems, IEEE STD 519-1992).. This requirement is necessary to minimize the adverse voltage effects experienced by other customers on EC's Distribution System. Generators may be connected and brought up to synchronous speed (as an induction motor) provided these flicker limits are not exceeded.

**D.2.e. Integration with EC's Distribution System Grounding.** The grounding scheme of the Generating Facility interconnection shall not cause over-voltages that exceed the rating of the equipment connected to the EC's Distribution System and shall not disrupt the coordination of the ground fault protection on the EC's Distribution System (IEEE1547-4.1.2) (See Section I.3.h).

**D.2.f. Frequency.** EC controls system frequency, and the Generating Facility shall operate in synchronism with the EC's Distribution System. Whenever EC's Distribution System frequency at the Point of Common Coupling varies from and

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remains outside normal (nominally 60 Hz) by the predetermined amounts set forth in Table D.2, the Generating Facility's Protective Functions shall cease to energize EC's Distribution System within the stated maximum trip time.:

Table D.2: Frequency Trip Settings

Generating Facility Rating	Frequency Range (Assuming 60Hz Nominal)	Maximum Trip Time [1] (Assuming 60 Cycles per Second)
Less or equal to 30kW	Less than 59.3 Hz	10 Cycles
	Greater than 60.5 Hz	10 Cycles
Greater than 30kW	Less than 57 Hz	10 Cycles
	Less than an adjustable value between 59.8Hz and 57 Hz but greater than 57 Hz. [2]	Adjustable between 10 and 18,000 Cycles. [2, 3]
	Greater than 60.5 Hz	10 Cycles

[1] - "Maximum Trip time" refers to the time between the onset of the abnormal condition and the Generating Facility ceasing to energize EC's Distribution System. Protective Function sensing equipment and circuits may remain connected to EC's Distribution System to allow sensing of electrical conditions for use by the "reconnect" feature. The purpose of the allowed time delay is to allow a Generating Facility to "ride through" short-term disturbances to avoid nuisance tripping. Set points shall not be user adjustable (though they may be field adjustable by qualified personnel). For Generating Facilities with a Gross Nameplate Rating greater than 30 kVA, set points shall be field adjustable and different voltage set points and trip times from those in Table D.2 may be negotiated with EC.

[2] - Unless otherwise required by EC, a trip frequency of 59.3 Hz and a maximum trip time of 10 cycles shall be used.

[3] - When a 10 cycle Maximum trip time is used, a second under frequency trip setting is not required.

**D.2.g. Harmonics.** When the Generating Facility is serving balanced linear loads, harmonic current injection into EC's Distribution System at the PCC shall not exceed the limits stated below in Table D.3. The harmonic current injections shall be exclusive of any harmonic currents due to harmonic voltage distortion present in EC's Distribution System without the Generating Facility connected (IEEE1547-4.3.3). The harmonic distortion of a Generating Facility located at a Customer's site shall be evaluated using the same criteria as for the Host Loads.

Table D.3: Maximum harmonic current distortion in percent of current (I) [1,2]

Individual harmonic order, h (odd harmonics) [3]	$h < 11$	$11 \leq h < 17$	$17 \leq h < 23$	$23 \leq h < 35$	$35 \leq h$	Total demand distortion (TDD)
Max Distortion (%)	4.0	2.0	1.5	0.6	0.3	5.0

[1] - IEEE1547-4.3.3

[2] -  $I$  = the greater of the maximum Host Load current average demand over 15 or 30 minutes without the GF, or the GF rated current capacity (transformed to the PCC when a transformer exists between the GF and the PCC).

[3] - Even harmonics are limited to 25% of the odd harmonic limits above.

**D.2.h. Direct Current Injection.** Generating Facilities should not inject direct current greater than 0.5% of rated output current into EC's Distribution System.

**D.2.i. Power Factor.** Each Generator in a Generating Facility shall be capable of operating at some point within a power factor range from 0.9 leading to 0.9 lagging. Operation outside this range is acceptable provided the reactive power of the Generating Facility is used to meet the reactive power needs of the Host Loads or

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that reactive power is otherwise provided under tariff by EC. The Producer shall notify EC if it is using the Generating Facility for power factor correction. Unless otherwise agreed upon by the Producer and EC, Generating Facilities shall automatically regulate power factor, not voltage, while operating in parallel with EC's Distribution System.

### D.3. TECHNOLOGY SPECIFIC REQUIREMENTS

**D.3.a. Three-Phase Synchronous Generators.** For three-phase Generators, the Generating Facility circuit breakers shall be three-phase devices with electronic or electromechanical control. The Producer shall be responsible for properly synchronizing its Generating Facility with EC's Distribution System by means of either manual or automatic synchronizing equipment. Automatic synchronizing is required for all synchronous Generators that have a Short Circuit Contribution Ratio (SCCR) exceeding 0.05. Loss of synchronism protection is not required except as may be necessary to meet Section D.2.d (Flicker) (IEEE1547-4.2.5). Unless otherwise agreed upon by the Producer and EC, synchronous Generators shall automatically regulate power factor, not voltage, while operating in parallel with EC's Distribution System. A power system stabilization Function is specifically not required for Generating Facilities under 10 MW Net Nameplate Rating.

**D.3.b. Induction Generators.** Induction Generators (except self-excited Induction Generators) do not require a synchronizing Function. Starting or rapid load fluctuations on induction generators can adversely impact EC's Distribution System's voltage. Corrective step-switched capacitors or other techniques may be necessary and may cause undesirable ferro-resonance. When these counter measures (e.g., additional capacitors) are installed on the Producer's side of the Point of Common Coupling, EC must review these measures. Additional equipment may be required as determined in a Supplemental Review or an Interconnection Study.

**D.3.c. Inverters.** Utility-interactive inverters do not require separate synchronizing equipment. Non-utility-interactive or "stand-alone" inverters shall not be used for Parallel Operation with EC's Distribution System.

**D.3.d. Single-Phase Generators.** For single-phase Generators connected to a shared single-phase secondary system, the maximum Net Nameplate Rating of the Generating Facilities shall be 20 kVA. Generators connected to a center-tapped neutral 240-volt service must be installed such that no more than 6 kVA of imbalanced power is applied to the two "legs" of the 240-volt service. For Dedicated Distribution Transformer services, the maximum Net Nameplate Rating of a single-phase Generating Facility shall be the transformer nameplate rating.

### D.4. SUPPLEMENTAL GENERATING FACILITY REQUIREMENTS

**D.4.a. Fault Detection.** A Generating Facility with an SCCR exceeding 0.1 or one that does not cease to energize EC's Distribution System within two seconds of the formation of an Unintended Island shall be equipped with Protective Functions designed to detect Distribution System faults, both line-to-line and line-to-ground, and shall cease to energize EC's Distribution System within two seconds of the initiation of a fault.

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- D.4.b. Transfer Trip.** For a Generating Facility that cannot detect Distribution System faults (both line-to-line and line-to-ground) or the formation of an Unintended Island, and cease to energize EC's Distribution System within two seconds, EC may require a Transfer Trip system or an equivalent Protective Function.
- D.4.c. Reclose Blocking.** Where the aggregate Generating Facility capacity exceeds 15% of the peak load on any automatic reclosing device, EC may require additional Protective Functions, including, but not limited to reclose-blocking on some of the automatic reclosing devices.

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### **E. INTERCONNECTION FACILITIES AND DISTRIBUTION SYSTEM MODIFICATIONS OWNERSHIP AND FINANCING**

#### **E.1. SCOPE AND OWNERSHIP OF INTERCONNECTION FACILITIES AND DISTRIBUTION SYSTEM MODIFICATIONS**

**E.1.a. Scope.** Parallel Operation of Generating Facilities may require Interconnection Facilities or modifications to EC's Distribution System ("Distribution System modifications"). The type, extent and costs of Interconnection Facilities and Distribution System modifications shall be consistent with this Rule and determined through the Supplemental Review and/or Interconnection Studies described in Section C.

**E.1.b. Ownership.** Interconnection Facilities installed on Producer's side of the Point of Common Coupling may be owned, operated and maintained by the Producer or EC. Interconnection Facilities installed on EC's side of the Point of Common Coupling and Distribution System modifications shall be owned, operated and maintained only by EC.

#### **E.2. RESPONSIBILITY OF COSTS OF INTERCONNECTING A GENERATING FACILITY**

**E.2.a. Study and Review Costs.** A Producer shall be responsible for the reasonably incurred costs of the reviews and studies conducted pursuant to Section C.1 of this Rule.

**E.2.b. Facility Costs.** A Producer shall be responsible for all costs associated with Interconnection Facilities owned by the Producer. The Producer shall also be responsible for any costs reasonably incurred by EC in providing, operating, or maintaining the Interconnection Facilities and Distribution System modifications required solely for the Interconnection of the Producer's Generating Facility with EC's Distribution System. Generating Facilities eligible for Net Energy Metering under California Public Utilities Code Sections 2827, 2827.8, 2827.9, or 2827.10 are exempt from any costs associated with Distribution System modifications.

**E.2.c. Separation of Costs.** Should EC combine the installation of Interconnection Facilities or Distribution System modifications required for the Interconnection of a Generating Facility with modifications to EC's Distribution System to serve other Customers or Producers, EC shall not include the costs of such separate or incremental facilities in the amounts billed to the Producer.

**E.2.d. Reconciliation of Costs and Payments.** If the Producer selected a fixed price billing for the Interconnection Facilities or Distribution System modifications, no reconciliation will be necessary. If the Producer selected actual cost billing, a true up will be required. Within a reasonable time after the Interconnection of a Producer's Generating Facility, EC will reconcile its actual costs related to the Generating Facility against any advance payments made by the Producer. The Producer will receive either a bill for any balance due or a reimbursement for overpayment as determined by EC's reconciliation. The Producer shall be entitled to a reasonably detailed and understandable accounting for the payments.

#### **E.3. INSTALLATION AND FINANCING OF INTERCONNECTION FACILITIES AND DISTRIBUTION SYSTEM MODIFICATIONS**

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- E.3.a. Agreement Required.** The costs for Interconnection Facilities and Distribution System modifications shall be paid by the Producer pursuant to the provisions contained in the Interconnection Agreement. Where the type and extent of the Interconnection Facilities or Distribution System modifications warrant additional detail, Producer and EC shall execute separate agreement(s) to more fully describe and allocate the parties' responsibilities for installing, owning, operating and maintaining the Interconnection Facilities and Distribution System modifications. These separate agreements shall be the following: EC's "Agreement for Installation or Allocation of Special Facilities for Parallel Operation of Non-Utility Owned Generation and/or Standby Service" (EC Form 79-280) and its Appendix A, "Detail of Special Facilities Charges" (EC Form 79-702), and EC's Applicable Tariff Schedules and Rules for Special Facilities.
- E.3.b. Interconnection Facilities and Distribution System Modifications.** Except as provided for in Sections E.2.b. and E.3.c. of this Rule, Interconnection Facilities connected to EC's side of the Point of Common Coupling and Distribution System modifications shall be provided, installed, owned and maintained by EC at Producer's expense.
- E.3.c. Third-Party Installations.** Subject to the approval of EC, a Producer may at its option employ a qualified contractor to provide and install Interconnection Facilities or Producer paid Distribution System modifications, to be owned and operated by EC, on EC's side of the Point of Common Coupling. Such Interconnection Facilities and Distribution System modifications shall be installed in accordance with EC's design and specifications. Upon final inspection and acceptance by EC, the Producer shall transfer ownership of such Producer installed Interconnection Facilities or Distribution System modifications to EC and such facilities shall thereafter be owned and maintained by EC at the Producer's expense. The Producer shall pay EC's reasonable cost of design, administration, and monitoring of the installation for such facilities to ensure compliance with EC's requirements. The Producer shall also be responsible for all costs, including any income tax liability, associated with the transfer of Producer installed Interconnection Facilities and Distribution System modifications to EC.
- E.3.d. Reservation of Unused Facilities.** When a Producer wishes to reserve EC-owned Interconnection Facilities or Distribution System modifications, installed and operated as Special Facilities for the Producer at Producer's expense, but idled by a change in the operation of the Producer's Generating Facility or otherwise, Producer may elect to abandon or reserve such facilities consistent with the terms of its agreement with EC. If Producer elects to reserve idle Interconnection Facilities or Distribution System modifications, EC shall be entitled to continue to charge Producer for the costs related to the ongoing operation and maintenance of the Special Facilities.
- E.3.e. Refund of Salvage Value.** When a Producer elects to abandon the Special Facilities for which it has either advanced the installed costs or constructed and transferred to EC, the Producer shall, at a minimum, receive from EC a credit for the net salvage value of the Special Facilities.

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## **F. METERING, MONITORING AND TELEMETRY**

### **F.1. GENERAL REQUIREMENTS**

All Generating Facilities shall be metered in accordance with this Section F and shall meet all applicable standards of EC contained in EC's applicable tariffs and published EC manuals dealing with Metering specifications.

### **F.2. METERING BY NON-EC PARTIES**

The ownership, installation, operation, reading and testing of revenue Metering Equipment for Generating Facilities shall be by EC except to the extent that the Commission authorizes any or all these services be performed by others.

### **F.3. NET GENERATION METERING**

For purposes of monitoring Generating Facility operation to determine standby charges and applicable non-bypassable charges as defined in EC's tariff, and for Distribution System planning and operations, consistent with Section B.4 of this Rule, EC shall have the right to specify the type, and require the installation of Net Generation Metering equipment. EC shall only require Net Generation Metering to the extent that less intrusive and/or more cost effective options for providing the necessary Generating Facility output data are not available. In exercising its discretion to require Net Generation Metering, EC shall consider all relevant factors, including but not limited to:

- a. Data requirements in proportion to need for information;
- b. Producer's election to install equipment that adequately addresses EC's operational requirements;
- c. Accuracy and type of required Metering consistent with purposes of collecting data;
- d. Cost of Metering relative to the need for and accuracy of the data;
- e. The Generating Facility's size relative to the cost of the Metering/monitoring;
- f. Other means of obtaining the data (e.g., Generating Facility logs, proxy data etc.); and
- g. Requirements under any Interconnection Agreement with the Producer.

EC will report to the Commission or designated authority, on a quarterly basis, the rationale for requiring Net Generation Metering equipment in each instance along with the size and location of the facility.

The requirements in this Section F.3 may not apply to Metering of Generating Facilities operating under EC's Net Energy Metering tariff pursuant to California Public Utilities Code Section 2827, 2827.8, 2827.9, and 2827.10.

### **F.4. POINT OF COMMON COUPLING METERING**

For purposes of assessing EC charges for retail service, the Producer's PCC Metering shall be reviewed by EC, and if required, replaced to ensure that it will appropriately measure electric power according to the provisions of the Customer's electric service Tariff. Where required,

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the Customer's existing meter may be replaced with a bi-directional meter so that power deliveries to and from the Producer's site can be separately recorded. Alternately, the Producer may, at its sole option and cost, require EC to install multi-metering equipment to separately record power deliveries to EC's Distribution System and retail purchases from EC. Where necessary, such PCC Metering shall be designed to prevent reverse registration.

Generating Facilities eligible for Net Energy Metering under Public Utilities Code Sections 2827, 2827.8, 2827.9, or 2827.10 shall have metering provided pursuant to the terms of the applicable Net Energy Metering tariff schedule.

### **F.5. TELEMETERING**

If the nameplate rating of the Generating Facility is 1 MW or greater, Telemetering equipment at the Net Generator Metering location may be required at the Producer's expense. If the Generating Facility is Interconnected to a portion of EC's Distribution System operating at a voltage below 10 kV, then Telemetering equipment may be required on Generating Facilities 250 kW or greater. EC shall only require Telemetering to the extent that less intrusive and/or more cost effective options for providing the necessary data in real time are not available. EC will report to the Commission or designated authority, on a quarterly basis, the rationale for requiring Telemetering equipment in each instance along with the size and location of the facility.

### **F.6. SUNSET PROVISION**

Sections F.3 and F.5 are interim provisions only. EC shall file permanent Metering requirements with the Commission on or by December 31, 2005. At that time, EC shall serve its application for approval of permanent Metering requirements on the service list in Order Instituting Rulemaking (OIR) 04-03-017.

### **F.7. LOCATION**

Where EC-owned Metering is located on the Producer's premises, Producer shall provide, at no expense to EC, a suitable location for all such Metering Equipment.

### **F.8. COSTS OF METERING**

The Producer will bear all costs of the Metering required by this Rule, including the incremental costs of operating and maintaining the Metering Equipment.

## **G. DISPUTE RESOLUTION PROCESS**

The following procedures will apply for disputes arising from this Rule:

- G.1.** The Commission shall have initial jurisdiction to interpret, add, delete or modify any provision of this Rule or of any agreements entered into between EC and the Producer to implement this tariff ("The Implementing Agreements") and to resolve disputes regarding EC's performance of its obligations under its tariffs, the applicable agreements, and requirements related to the Interconnection of the Producer's Generating or Interconnection Facilities pursuant to this Rule.
- G.2.** Any dispute arising between EC and the Producer (individually "Party" and collectively "the Parties") regarding EC's or Producer's performance of its obligations under its tariffs,



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the Implementing Agreements, and requirements related to the Interconnection of Producer's Facilities pursuant to this Rule shall be resolved according to the following procedures:

- a. The dispute shall be reduced to writing by the aggrieved Party in a letter ("the dispute letter") to the other Party containing the relevant known facts pertaining to the dispute, the specific dispute and the relief sought, and express notice by the aggrieved Party that it is invoking the procedures under Section G.2. Within 45 calendar days of the date of the dispute letter, the Parties' authorized representatives will be required to meet and confer to try to resolve the dispute.
- b. If the Parties do not resolve their dispute within 45 calendar days after the date of the dispute letter, the dispute shall, upon demand of either party, be submitted to resolution before the Commission in accordance with the Commission's Rules of Practice and Procedure Applicable to Customer Complaints.

**G.3.** Pending resolution of any dispute under this Section, the Parties shall proceed diligently with the performance of their respective obligations under this Rule and the Implementing Agreements, unless the Implementing Agreements have been terminated. Disputes as to the application and implementation of this Section shall be subject to resolution pursuant to the procedures set forth in this Section.

### H. DEFINITIONS

The definitions in this Section H are applicable only to this Rule, the Application and Interconnection Agreements.

**Anti-Islanding:** A control scheme installed as part of the Generating Facility or Interconnection Facilities that senses and prevents the formation of an Unintended Island.

**Applicant:** The entity submitting an Application for Interconnection pursuant to this Rule.

**Application:** A Commission-approved standard form submitted to EC for Interconnection of a Generating Facility.

**Certification Test:** A test pursuant to this Rule that verifies conformance of certain equipment with Commission-approved performance standards in order to be classified as Certified Equipment. Certification Tests are performed by NRTLs.

**Certification; Certified; Certificate:** The documented results of a successful Certification Testing.

**Certified Equipment:** Equipment that has passed all required Certification Tests.

**Commission:** The Public Utilities Commission of the State of California.

**Commissioning Test:** A test performed during the commissioning of all or part of a Generating Facility to achieve one or more of the following:

- Verify specific aspects of its performance;
- Calibrate its instrumentation; and
- Establish instrument or Protective Function set-points.

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**Customer:** The entity that receives or is entitled to receive Distribution Service through the EC's Distribution System.

**Dedicated Transformer; Dedicated Distribution Transformer:** A transformer that provides electricity service to a single Customer. The Customer may or may not have a Generating Facility.

**Device:** A mechanism or piece of equipment designed to serve a purpose or perform a function. The term may be used interchangeably with the terms "equipment" and "function" without intentional difference in meaning. See also Function and Protective Function.

**Distribution Service:** All services required by, or provided to, a Customer pursuant to the approved tariffs of EC other than services directly related to the Interconnection of a Generating Facility under this Rule.

**Distribution System:** All electrical wires, equipment, and other facilities owned or provided by EC, other than Interconnection Facilities, by which EC provides Distribution Service to its Customers.

**Emergency:** An actual or imminent condition or situation, which jeopardizes EC's Distribution System Integrity.

**Field Testing:** Testing performed in the field to determine whether equipment meets EC's requirements for safe and reliable Interconnection.

**Function:** Some combination of hardware and software designed to provide specific features or capabilities. Its use, as in Protective Function, is intended to encompass a range of implementations from a single-purpose device to a section of software and specific pieces of hardware within a larger piece of equipment to a collection of devices and software.

**Generating Facility:** All Generators, electrical wires, equipment, and other facilities owned or provided by Producer for the purpose of producing electric power.

**Generator:** A device converting mechanical, chemical or solar energy into electrical energy, including all of its protective and control Functions and structural appurtenances. One or more Generators comprise a Generating Facility.

**Gross Nameplate Rating; Gross Nameplate Capacity:** The total gross generating capacity of a Generator or Generating Facility as designated by the manufacturer(s) of the Generator(s).

**Host Load:** The electrical power, less the Generator auxiliary load, consumed by the Customer, to which the Generating Facility is connected.

**Initial Review:** The review by EC, following receipt of an Application, to determine the following: (a) the Generating Facility qualifies for Simplified Interconnection; or (b) if the Generating Facility can be made to qualify for Interconnection with a Supplemental Review determining any additional requirements.

**In-rush Current:** The current determined by the In-rush Current Test.

**Interconnection Agreement:** An agreement between EC and the Producer providing for the Interconnection of a Generating Facility that gives certain rights and obligations to effect or end Interconnection. For the purposes of this Rule, Net Energy Metering or Power Purchase Agreements authorized by the Commission are also defined as Interconnection Agreements.

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**Interconnection; Interconnected:** The physical connection of a Generating Facility in accordance with the requirements of this Rule so that Parallel Operation with EC's Distribution System can occur (has occurred).

**Interconnection Facilities:** The electrical wires, switches and related equipment that are required in addition to the facilities required to provide electric Distribution Service to a Customer to allow Interconnection. Interconnection Facilities may be located on either side of the Point of Common Coupling as appropriate to their purpose and design. Interconnection Facilities may be integral to a Generating Facility or provided separately.

**Interconnection Study:** A study to establish the requirements for Interconnection of a Generating Facility with EC's Distribution System.

**Island; Islanding:** A condition on EC's Distribution System in which one or more Generating Facilities deliver power to Customers using a portion of EC's Distribution System that is electrically isolated from the remainder of EC's Distribution System.

**Line Section:** That portion of EC's Distribution System connected to a Customer bounded by automatic sectionalizing devices or the end of the distribution line.

**Load Carrying Capability:** The maximum electrical load that may be carried by a section of EC's Distribution System consistent with reliability and safety under the circumstances being evaluated.

**Metering:** The measurement of electrical power in kW and/or energy in kWh, and, if necessary, reactive power in kVAR at a point, and its display to EC, as required by this Rule.

**Metering Equipment:** All equipment, hardware, software including meter cabinets, conduit, etc., that are necessary for Metering.

**Momentary Parallel Operation:** The interconnection of a Generating Facility to the Distribution System for one second (60 cycles) or less.

**Nationally Recognized Testing Laboratory (NRTL):** A laboratory accredited to perform the Certification Testing requirements under this Rule.

**Net Energy Metering:** Metering for the receipt and delivery of electricity between the Producer and EC pursuant to Section 2827, 2827.8, 2827.9, or 2827.10 of the Public Utilities Code.

**Net Generation Metering:** Metering of the net electrical power output in kW or energy in kWh, from a given Generating Facility. This may also be the measurement of the difference between the total electrical energy produced by a Generator and the electrical energy consumed by the auxiliary equipment necessary to operate the Generator. For a Generator with no Host Load and/or Public Utilities Code Section 218 Load (Section 218 Load), Metering that is located at the Point of Common Coupling. For a Generator with Host Load and/or Section 218 Load, Metering that is located at the Generator but after the point of auxiliary load(s) and prior to serving Host Load and/or Section 218 Load.

**Net Nameplate Rating:** The Gross Nameplate Rating minus the consumption of electrical power of a Generator or Generating Facility as designated by the manufacturer(s) of the Generator(s).

**Network Service:** More than one electrical feeder providing Distribution Service at a Point of Common Coupling.

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**Non-Export; Non-Exporting:** Designed to prevent the transfer of electrical energy from the Generating Facility to EC's Distribution System.

**Non-Islanding:** Designed to detect and disconnect an Unintended Island with matched load and generation. Reliance solely on under/over voltage and frequency trip is not considered sufficient to qualify as Non-Islanding.

**Parallel Operation:** The simultaneous operation of a Generator with power delivered or received by EC while Interconnected. For the purpose of this Rule, Parallel Operation includes only those Generating Facilities that are Interconnected with EC's Distribution System for more than 60 cycles (one second).

**Paralleling Device:** An electrical device, typically a circuit breaker, operating under the control of a synchronization function or by a qualified operator to connect an energized generator to an energized electric power system or two energized power systems to each other.

**Periodic Test:** A test performed on part or all of a Generating Facility/ Interconnection Facilities at pre-determined time or operational intervals to achieve one or more of the following: (1) Verify specific aspects of its performance; (2) Calibrate instrumentation; and (3) Verify and re-establish instrument or Protective Function set-points.

**Point of Common Coupling (PCC):** The transfer point for electricity between the electrical conductors of EC and the electrical conductors of the Producer.

**Point of Common Coupling Metering:** Metering located at the Point of Common Coupling. This is the same Metering as Net Generation Metering for Generating Facilities with no Host Load and/or Section 218 Load.

**Point of Interconnection:** The electrical transfer point between a Generating Facility and EC's Distribution System. This may or may not be coincident with the Point of Common Coupling.

**Producer:** The entity that executes an Interconnection Agreement with EC. The Producer may or may not own or operate the Generating Facility, but is responsible for the rights and obligations related to the Interconnection Agreement.

**Production Test:** A test performed on each device coming off the production line to verify certain aspects of its performance.

**Protective Function(s):** The equipment, hardware and/or software in a Generating Facility (whether discrete or integrated with other functions) whose purpose is to protect against Unsafe Operating Conditions.

**Prudent Electrical Practices:** Those practices, methods, and equipment, as changed from time to time, that are commonly used in prudent electrical engineering and operations to design and operate electric equipment lawfully and with safety, dependability, efficiency and economy.

**Scheduled Operation Date:** The date specified in the Interconnection Agreement when the Generating Facility is, by the Producer's estimate, expected to begin operation pursuant to this Rule.

**Secondary Network:** A network supplied by several primary feeders suitably interlaced through the area in order to achieve acceptable loading of the transformers under emergency conditions and to provide a system of extremely high service reliability. Secondary networks usually operate at 600 V or lower.

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**Section 218 Load:** Electrical power that is supplied in compliance with California Public Utilities Code Section 218. Public Utilities Code Section 218 defines an “Electric Corporation” and provides conditions under which a transaction involving a Generating Facility would not classify a Producer as an Electric Corporation. These conditions relate to “over-the-fence” sale of electricity from a Generating Facility without using EC’s Distribution System.

**Short Circuit (Current) Contribution Ratio (SCCR):** The ratio of the Generating Facility’s short circuit contribution to the short circuit contribution provided through EC’s Distribution System for a three-phase fault at the high voltage side of the distribution transformer connecting the Generating Facility to EC’s system.

**Simplified Interconnection:** Interconnection conforming to the Initial Review requirements under this Rule, as determined by Section I.

**Single Line Diagram; Single Line Drawing:** A schematic drawing, showing the major electric switchgear, Protective Function devices, wires, Generators, transformers and other devices, providing sufficient detail to communicate to a qualified engineer the essential design and safety of the system being considered.

**Special Facilities:** As defined in EC’s Rules governing Special Facilities.

**Starting Voltage Drop:** The percentage voltage drop at a specified point resulting from In-rush Current. The Starting Voltage Drop can also be expressed in volts on a particular base voltage, (e.g., 6 volts on a 120-volt base, yielding a 5% drop).

**Supplemental Review:** A process wherein EC further reviews an Application that fails one or more of the Initial Review Process screens. The Supplemental Review may result in one of the following: (a) approval of Interconnection; (b) approval of Interconnection with additional requirements; or (c) cost and schedule for an Interconnection Study.

**System Integrity:** The condition under which EC’s Distribution System is deemed safe and can reliably perform its intended functions in accordance with the safety and reliability rules of EC.

**Telemetry:** The electrical or electronic transmittal of Metering data in real-time to EC.

**Transfer Trip:** A Protective Function that trips a Generating Facility remotely by means of an automated communications link controlled by EC.

**Type Test:** A test performed on a sample of a particular model of a device to verify specific aspects of its design, construction and performance.

**Unintended Island:** The creation of an island, usually following a loss of a portion of EC’s Distribution System, without the approval of EC.

**Unsafe Operating Conditions:** Conditions that, if left uncorrected, could result in harm to personnel, damage to equipment, loss of System Integrity or operation outside pre-established parameters required by the Interconnection Agreement.

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## **I. REVIEW PROCESS FOR APPLICATIONS TO INTERCONNECT GENERATING FACILITIES**

### **I.1. INTRODUCTION**

This Review Process allows for rapid approval for the interconnection of those Generating Facilities that do not require an Interconnection Study. The review process includes a screening to determine if a Supplemental Review is required.

Note: Failure to pass any screen of the review process means only that further review and/or studies are required before the Generating Facility can be approved for Interconnection with EC's Distribution System. It does not mean that the Generating Facility cannot be Interconnected. Though not explicitly covered in the Initial Review Process the Generating Facility shall be designed to meet all of the applicable requirements in Section D.

### **I.2. PURPOSE**

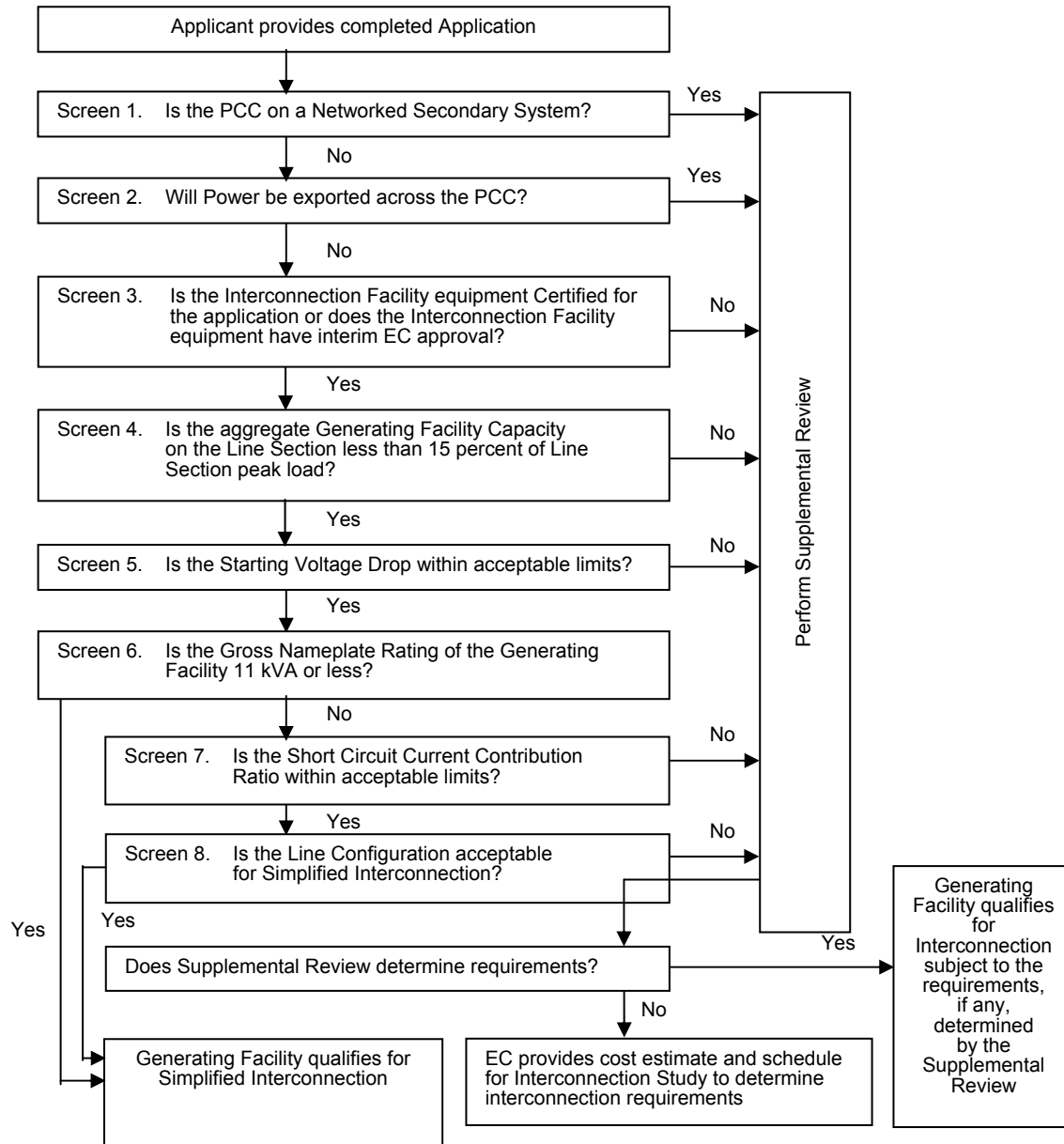
The review determines the following:

- a. If a Generating Facility qualifies for Simplified Interconnection;
- b. If a Generating Facility can be made to qualify for Interconnection with a Supplemental Review determining any additional requirements; or
- c. If an Interconnection Study is required, the cost estimate and schedule for performing the Interconnection Study.

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## I.3. REVIEW PROCESS DETAILS

Initial and Supplemental Review Process Flow Chart



### I.3.a. Screen 1: Is the PCC on a Networked Secondary System?

- If Yes, the Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review.
- If No, continue to next screen.

Significance: Special considerations must be given to Generating Facilities proposed to be installed on networked secondary Distribution Systems because of the design and

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operational aspects of network protectors. There are no such considerations for radial Distribution Systems.

### **I.3.b. Screen 2: Will power be exported across the PCC?**

- If Yes, the Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review.
- If No, the Generating Facility must incorporate one of the following four options:

Option 1 (“Reverse Power Protection”): To ensure that power is not exported across the PCC, a reverse power Protective Function may be provided.. The default setting for this Protective Function, when used, shall be 0.1% (export) of the service transformer’s rating, with a maximum 2.0 second time delay.

Option 2 (“Minimum Power Protection”): To ensure that at least a minimum amount of power is imported across the PCC at all times (and therefore, that power is not exported), an under-power Protective Function may be provided.. The default setting for this Protective Function, when used, shall be 5% (import) of the Generating Facility’s total Gross Nameplate Rating, with a maximum 2.0 second time delay.

Option 3 (“Certified Non-Islanding Protection”): To ensure that the incidental export of power across the PCC is limited to acceptable levels, this option, when used, requires that all of the following conditions be met: (a) the total Gross Nameplate Capacity of the Generating Facility must be no more than 25% of the nominal ampere rating of the Producer’s service equipment; (b) the total Gross Nameplate Capacity of the Generating Facility must be no more than 50% of the Producer’s service transformer capacity rating (this capacity requirement does not apply to customers taking primary service without an intervening transformer); and (c) the Generating Facility must be certified as Non-Islanding.

The ampere rating of the Customer’s Service Equipment to be used in this evaluation will be that rating for which the customer’s utility service was originally sized or for which an upgrade has been approved. It is not the intent of this provision to allow increased export simply by increasing the size of the customer’s service panel, without separate approval for the resize.

Option 4 (“Relative Generating Facility Rating”): This option, when used, requires Net Nameplate Rating of the Generating Facility to be so small in comparison to its host facility’s minimum load, that the use of additional Protective Functions is not required to insure that power will not be exported to EC’s Distribution System. This option requires the Generating Facility capacity to be no greater than 50% of the Producer’s verifiable minimum Host Load over the past 12 months.

Significance:

- 1) If it can be ensured that the Generating Facility will not export power, EC’s Distribution System does not need to be studied for Load-Carrying Capability or Generating Facility power flow effects on EC voltage regulators.
- 2) This Screen permits the use of reverse-power or minimum-power relaying as a Non-Islanding Protective Function (Options 1, 2 and 3).



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- 3) This Screen allows, under certain defined conditions, for Generating Facilities that incorporate Certified Non-Islanding protection to qualify for Simplified Interconnection without implementing reverse power or minimum power Protective Functions (Option 3).

**I.3.c. Screen 3: Is the Interconnection Facilities equipment Certified for the application or does the Interconnection Facilities equipment have interim EC approval?**

- If Yes, continue to next screen.
- If No, the Generating Facility and/or Interconnection Facilities does not qualify for Simplified Interconnection. Perform Supplemental Review.

Interim approval allows the EC to treat equipment that has not completed the Rule 21 certification requirements as having met the intent of this screen. Interim approval is granted, at EC's discretion, on a case by case basis, and approval for one Generating Facility does not guarantee approval for any other Generating Facility

Significance: If the Generating Facility and/or Interconnection Facilities has been Certified or previously approved by EC, EC does not need to repeat its full review and/or test of the Generating and/or Interconnection Facilities' Protective Functions. Site Commissioning Testing may still be required to insure that the Protective Functions are working properly.

Certification indicates that the criteria in Section J, as appropriate, have been tested and verified.

**I.3.d. Screen 4: Is the aggregate Generating Facility capacity on the Line Section less than 15% of Line Section peak load?**

- If Yes, continue to next screen.
- If No, the Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review to determine cumulative impact on Line Section.

Significance:

- 1) Low penetration of Generating Facility installations will have a minimal impact on the operation and load restoration efforts of EC's Distribution System.
- 2) The operating requirements for a high penetration of Generating Facilities may be different since the impact on EC's Distribution System will no longer be minimal, therefore requiring additional study or controls.

**I.3.e. Screen 5: Is the Starting Voltage Drop within acceptable limits?**

- If Yes, continue to next screen.
- If No, the Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review.

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Note: This Screen only applies to Generating Facilities that start by motoring the Generator(s).

EC has two options in determining whether Starting Voltage Drop is acceptable. The option to be used is at EC's discretion:

Option 1: EC may determine that the Generating Facility's starting In-rush Current is equal to or less than the continuous ampere rating of the customer's service equipment.

Option 2: EC may determine the impedances of the service distribution transformer (if present) and the secondary conductors to Customer's service equipment and perform a voltage drop calculation. Alternatively, EC may use tables or nomographs to determine the voltage drop. Voltage drops caused by starting a Generator as a motor must be less than 2.5% for primary interconnections and 5% for secondary interconnections.

Significance:

- 1) This Screen addresses potential voltage fluctuation problems that may be caused by Generators that start by motoring.
- 2) When starting, Generating Facilities should have minimal impact on the service voltage to other EC Customers.
- 3) Passing this screen does not relieve the Producer from ensuring that its Generating Facility complies with the flicker requirements of this Rule, Section D.2.d.

### **I.3.f. Screen 6: Is the Gross Nameplate Rating of the Generating Facility 11 kVA or less?**

- If Yes, the Generating Facility qualifies for Simplified Interconnection. Skip remaining screens.
- If No, continue to next screen.

Significance: The Generating Facility will have a minimal impact on fault current levels and any potential line overvoltages from loss of EC's Distribution System neutral grounding.

### **I.3.g. Screen 7: Is the Short Circuit Current Contribution Ratio within acceptable limits?**

- If Yes, continue to next screen.
- If No, the Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review.

The Short Circuit Current Contribution Ratio Screen consists of two criteria; both of which must be met when applicable:

- 1) When measured at primary side (high side) of a Dedicated Distribution Transformer serving a Generating Facility, the sum of the Short Circuit Contribution Ratios of all generating facilities connected to EC's Distribution System circuit that serves the Generating Facility must be less than or equal to 0.1, and

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- 2) When measured at the secondary side (low side) of a shared distribution transformer, the short circuit contribution of the proposed Generating Facility must be less than or equal to 2.5% of the interrupting rating of the Producer's Service Equipment.

Significance: If the Generating Facility passes this screen it can be expected that it will have no significant impact on EC's Distribution System's short circuit duty, fault detection sensitivity, relay coordination or fuse-saving schemes.

### I.3.h. Screen 8: Is the Line Configuration compatible with the Interconnection type?

- If Yes, the Generating Facility qualifies for Simplified Interconnection.
- If No, then the Generating Facility does not qualify for Simplified Interconnection. Perform Supplemental Review.

Line Configuration Screen: Identify primary distribution line configuration that will serve the Generating Facility. Based on the type of Interconnection to be used for the Generating Facility, determine from the Table I.1 if the proposed Generating Facility passes the screen.

Primary Distribution Line Type Configuration	Table I.1 Type of Interconnection to be Made to Primary Distribution Line	Results/Criteria
Three-phase, three wire	Any type	Pass Screen
Three-phase, four wire	Single-phase, line-to-neutral	Pass Screen
Three-phase, four wire (For any line that has such a section OR mixed three wire and four wire)	All others	To pass, aggregate GF Nameplate Rating must be less than or equal to 10% of Line Section peak load

Significance: If the primary distribution line serving the Generating Facility is of a "three-wire" configuration, or if the Generating Facility's distribution transformer is single-phase and connected in a line-to-neutral configuration, then there is no concern about overvoltages to EC's, or other Customer's equipment caused by loss of system neutral grounding during the operating time of the Non-Islanding Protective Function.

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## J. CERTIFICATION AND TESTING CRITERIA

### J.1. INTRODUCTION

This Section describes the test procedures and requirements for equipment used for the Interconnection of Generating Facilities to EC's Distribution System. Included are Type Testing, Production Testing, Commissioning Testing and Periodic Testing. The procedures listed rely heavily on those described in appropriate Underwriters Laboratory (UL), Institute of Electrical and Electronic Engineers (IEEE), and International Electrotechnical Commission (IEC) documents—most notably UL 1741 and IEEE 929, as well as the testing described in *May 1999 New York State Public Services Commission Standardized Interconnection Requirements*. As noted in Section A, this rule has been revised to be consistent with ANSI/IEEE 1547-2003 *Standard for Interconnecting Distributed Resources with Electric Power Systems*.

The tests described here, together with the technical requirements in Section D of this Rule, are intended to provide assurance that the Generating Facility's equipment will not adversely affect EC's Distribution System and that a Generating Facility will cease providing power to EC's Distribution System under abnormal conditions. The tests were developed assuming a low level of Generating Facility penetration or number of connections to EC's Distribution System. At high levels of Generating Facility penetration, additional requirements and corresponding test procedures may need to be defined.

Section J also provides criteria for "Certifying" Generators or inverters. Once a Generator or inverter has been Certified per this Rule, it may be considered suitable for Interconnection with EC's Distribution System. Subject to the exceptions described in Section J, EC will not repeat the design review or require retesting of such Certified Equipment. It should be noted that the Certification process is intended to facilitate Generating Facility Interconnections. Certification is not a prerequisite to interconnect a Generating Facility.

The revisions made to this rule relative to IEEE 1547-2003 have resulted in changes in set points, test criteria, test procedures, and other requirements that will impact previously certified or listed equipment as well as equipment currently under evaluation. These changes were made to provide consistency with IEEE 1547. Equipment that is certified or that has been submitted to a Nationally Recognized Testing Laboratory (NRTL) for testing on or before December 31, 2004 and that subsequently meets the previous Rule 21 certification requirements will continue to be accepted as certified equipment through December 31, 2005.

### J.2. CERTIFIED AND NON-CERTIFIED INTERCONNECTION EQUIPMENT

#### J.2.a. Certified Equipment

Equipment tested and approved (e.g., "Listed") by an accredited NRTL as having met both the Type Testing and Production Testing requirements described in this document is considered to be Certified Equipment for purposes of Interconnection with EC's Distribution System. Certification may apply to either a pre-packaged system or an assembly of components that address the necessary functions. Type Testing may be done in the manufactures' factory or test laboratory, or in the field. At the discretion of the testing laboratory, field-certification may apply only to the particular installation tested. In such cases, some or all of the tests may need to be repeated at other installations.

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When equipment is Certified by a NRTL, the NRTL shall provide to the manufacturer, at a minimum, a Certificate with the following information for each device:

### **Administrative:**

- 1) The effective date of Certification or applicable serial number (range or first in series), and/or other proof that Certification is current;
- 2) Equipment model number(s) of the Certified Equipment;
- 3) The software version utilized in the equipment, if applicable;
- 4) Test procedures specified (including date or revision number); and
- 5) Laboratory accreditation (by whom and to what standard).

### **Technical (as appropriate):**

- 1) Device ratings (kW, kVA, Volts, Amps, etc.);
- 2) Maximum available fault current in Amps;
- 3) In-rush Current in Amps;
- 4) Trip points, if factory set (trip value and timing);
- 5) Trip point and timing ranges for adjustable settings;
- 6) Nominal power factor or range if adjustable;
- 7) If the equipment is Certified for Non-Exporting and the method used (reverse power or under power); and
- 8) If the equipment is Certified Non-Islanding.

It is the responsibility of the equipment manufacturer to ensure that Certification information is made publicly available by the manufacturer, the testing laboratory or by a third party.

### **J.2.b. Non-Certified Equipment**

For non-Certified Equipment, some or all of the tests described in this Rule may be required by EC for each Generating Facility and/or Interconnection Facilities. The manufacturer or a laboratory acceptable to EC may perform these tests. Test results for Non-Certified Equipment must be submitted to EC for the Supplemental Review. Approval by EC for equipment used in a particular Generating Facility and/or Interconnection Facilities does not guarantee EC's approval for use in other Generating Facility and/or Interconnection Facilities.

## **J.3. TYPE TESTING**

**J.3.a. Type Tests and Criteria for Interconnection Equipment Certification.** Type Testing provides a basis for determining that equipment meets the specifications for being designated as Certified Equipment under this Rule. The requirements

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described in this Section cover only issues related to Interconnection and are not intended to address equipment safety or other issues.

Table J.1. defines the test criteria by Generator or inverter technology. While UL 1741<sup>1</sup> was written specifically for inverters, the requirements are readily adaptable to synchronous Generators, induction Generators, as well as single/multi-function controllers and protection relays. Until a universal test standard is developed, EC or NRTL shall adapt the procedures referenced in Table J.1 as appropriate and necessary for a Generating Facility and/or Interconnection Facilities or associated equipment performance and its control and Protective Functions. The tests shall be performed in the sequence shown in Table J.2 below.

**Table J.1 Type Tests and Requirements for Interconnection Equipment Certification**

Type Test	Reference (1)	Inverter	Synchronous Generator	Induction Generator
Utility Interaction	UL 1741 – 39	X	X	X
DC Isolation	UL 1741 – 40.1	X	—	—
Simulated PV Array (Input) Requirements	UL 1741 – 41.2	X	—	—
Dielectric Voltage Withstand	UL 1741 – 44	X	X	X
Power Factor	UL 1741 – 45.2.2	X	X	X
Harmonic Distortion	UL 1741 – 45.4	X	X	X
DC Injection	UL 1741 – 45.5	X	—	—
Utility Voltage and Frequency Variation	UL 1741 – 46.2	X	X	X
Reset Delay	UL 1741 – 46.2.3	X	X	X
Loss of Control Circuit	UL 1741 – 46.4	X	X	X
Short Circuit	UL 1741 – 47.3	X	X	X
Load Transfer	UL 1741 – 47.7	X	X	X
Surge Withstand Capability	J.3.e	X	X	X
Anti-Islanding	J.3.b	(2)	(2)	(2)
Non-Export	J.3.c	(3)	(3)	(3)
In-rush Current	J.3.d	—	—	(4)
Synchronization	J.3.f	(5)	X	(5)

Table Notes: (1) References are to section numbers in either UL 1741 (Inverters, Converters and Charge Controllers for use in Independent Power Systems) or this Rule. References in UL 1741 to “photovoltaics” or “inverter” may have to be adapted to the other technologies by the testing laboratory to appropriately apply in the tests to other technologies.  
 (2) Required only if Non-Islanding designation.  
 (3) Required only if Non-Export designation is desired.  
 (4) Required for Generators that use EC power to motor to speed.  
 (5) Required for all self-excited induction generators and Inverters that operate as voltage sources when connected to EC.  
 X = Required  
 — = Not Required

Test No.	Type Test
1	Utility Voltage and Frequency Variation
2	Synchronization
3	Surge Withstand Capability
4	Utility Voltage and Frequency Variation
5	Synchronization
6	Other Required and Optional Tests
Tests 1, 2, and 3 must be done first and in the order shown. Tests 4 and on follow in order convenient to the testing agency.	

Table J.2 Type Tests Sequence for Interconnection Equipment Certification

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### J.3.b. Anti-Islanding Test

Devices that pass the Anti-Islanding test procedure described in UL 1741 Section 46.3 will be considered Non-Islanding for the purposes of these interconnection requirements. The test is required only for devices for which a Certified Non-Islanding designation is desired.

### J.3.c. Non-Export Test

Equipment that passes the Non-Export test procedure described in Section J.7.a. will be considered Non-Exporting for the purposes of these Interconnection requirements. This test is required only for equipment for which a Certified Non-Export designation is desired.

### J.3.d. In-rush Current Test

Generation equipment that utilizes EC power to motor up to speed will be tested using the procedure defined in Section J.7.b. to determine the maximum current drawn during this startup process. The resulting In-rush Current is used to estimate the Starting Voltage Drop.

### J.3.e. Surge Withstand Capability Test

The interconnection equipment shall be tested for the surge withstand requirement in D.1.c in all normal operating modes in accordance with IEEE Std C62.45-2002 for equipment rated less than 1000 V to confirm that the surge withstand capability is met by using the selected test level(s) from IEEE Std C62.41.2-2002. Interconnection equipment rated greater than 1000 V shall be tested in accordance with manufacturer or system integrator designated applicable standards. For interconnection equipment signal and control circuits, use IEEE Std C37.90.1-2002. These tests shall confirm the equipment did not fail, did not misoperate, and did not provide misinformation (IEEE1547-5.1.3.2).

The location/exposure category for which the equipment has been tested shall be clearly marked on the equipment label or in the equipment documentation. External surge protection may be used to protect the equipment in harsher location/exposure categories.

### J.3.f. Synchronization Test

This test is applied to synchronous Generators, self-excited induction generators, and inverters capable of operating as voltage-source while connected to EC's Distribution System. The test is also applied to the resynchronization Function (transition from stand-alone to parallel operation) on equipment that provides such functionality<sup>2</sup>. This test is not necessary for induction generators or current-source inverters. Instead, the In-rush Current test Section J.3.d shall be applied to those generators.

This test shall demonstrate that at the moment of the paralleling-device closure, all three synchronization parameters in Table J.3 are within the stated limits. This test shall also demonstrate that if any of the parameters are outside of the limits stated in the table, the paralleling-device shall not close (IEEE1547-5.1.2A). The test will start with only one of the three parameters: (1) voltage difference between Generating Facility and EC's Distribution System; (2) frequency difference; or (3) phase angle outside of the

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<sup>2</sup> The test may not need to be performed on both the synchronization and re-synchronization functions if the manufacturer can verify to the satisfaction of the testing organization that monitoring and controls hardware and software are common to both functions

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synchronization specification . Verify that the Generating Facility is brought within specification prior to synchronization. Repeat the test five times for each of the three parameters. For manual synchronization with synch check or manual control with auto synchronization, the test must verify that paralleling does not occur until the parameters are brought within specifications.

Table J.3. Synchronization Parameter Limits<sup>[1]</sup>

Aggregate Rating of Generator Units (kVA)	Frequency Difference ( $\Delta f$ , Hz)	Voltage Difference ( $\Delta V$ , %)	Phase Angle Difference ( $\Delta \Phi$ , °)
0 – 500	0.3	10	20
> 500 – 1,500	0.2	5	15
> 1,500 - 10,000	0.1	3	10

<sup>[1]</sup> - IEEE1547-5.1.1B

### J.3.g. Paralleling Device Withstand Test

The di-electric voltage withstand test specified in J.1 shall be performed on the paralleling device to ensure compliance with those requirements specified in D.1.c (IEEE1547-5.1.3.3).

## J.4. PRODUCTION TESTING

As a minimum, each interconnection system shall be subjected to the Utility Voltage and Frequency Variation Test procedure described in UL1741 under Manufacturing and Production Tests, Section 68 and the Synchronization test specified in J.3.f. Interconnection systems with adjustable set points shall be tested at a single set of set points as specified by the manufacturer\ . This testing may be performed in the factory or as part of a Commissioning Test (Section J.5.).

## J.5. COMMISSIONING TESTING

**J.5.a.** Commissioning Testing, where required, will be performed on-site to verify protective settings and functionality. Upon initial Parallel Operation of a Generating Facility, or any time interface hardware or software is changed that may affect the functions listed below, a Commissioning Test must be performed. An individual qualified in testing protective equipment (professional engineer, factory-Certified technician, or licensed electrician with experience in testing protective equipment) must perform Commissioning Testing in accordance with the manufacturer's recommended test procedure to verify the settings and requirements per this Rule.

EC may require a written commissioning test procedure be submitted to the EC at least 10 working days prior to the performance of the commissioning test. EC has the right to witness Commissioning Tests. EC may also require written Certification by the installer describing which tests were performed and their results. Protective Functions to be tested during commissioning, particularly with respect to non-Certified Equipment, may consist of the following:



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- Over and under voltage
- Over and under frequency
- Anti-Islanding Function (if applicable)
- Non-Export Function (if applicable)
- Inability to energize dead line
- Time delay on restart after utility source is stable
- Utility system fault detection (if used)
- Synchronizing controls (if applicable)
- Other Interconnection Protective Functions that may be required as part of the Interconnection Agreement

Commissioning test shall include visual inspections of the interconnection equipment and protective settings to confirm compliance with the interconnection requirements.

**J.5.b.** Other checks and tests that may need to be performed include:

- Verifying final Protective Function settings
- Trip test (J.5.f)
- In-service test (J.5.g)

### **J.5.c. Certified Equipment**

Generating Facilities qualifying for Simplified Interconnection incorporate Certified Equipment have, at a minimum, passed the Type Tests and Production Tests described in this Rule and are judged to have little or no potential impact on EC's Distribution System. For such Generating Facilities, it is necessary to perform only the following tests:

- 1) Protective Function settings that have been changed after Production Testing will require field verification. Tests shall be performed using injected secondary frequencies, voltages and currents, applied waveforms, at a test connection using a Generator to simulate abnormal utility voltage or frequency, or varying the set points to show that the device trips at the measured (actual) utility voltage or frequency.
- 2) The Non-Islanding Function will be checked by operating a load break disconnect switch to verify the Interconnection equipment ceases to energize EC's Distribution System and does not re-energize it for the required time delay after the switch is closed.
- 3) The Non-Exporting Function shall be checked using secondary injection techniques. This function may also be tested by adjusting the Generating Facility output and local loads to verify that the applicable Non-Exporting criteria (i.e., reverse power or under power) are met.

The Supplemental Review or an Interconnection Study may impose additional components or additional testing.

### **J.5.d. Non-Certified Equipment**

Non-Certified Equipment shall be subjected to the appropriate tests described in Type Testing (Section J.3.) as well as those described in Certified Equipment

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Commissioning Tests (Section J.5.c.). With EC's approval, these tests may be performed in the factory, in the field as part of commissioning, or a combination of both. EC, at its discretion, may also approve a reduced set of tests for a particular Generating Facility or, for example, if it determines it has sufficient experience with the equipment.

### **J.5.e. Verification of Settings**

At the completion of Commissioning testing, the Producer shall confirm all devices are set to EC-approved settings. Verification shall be documented in the Commissioning Test Certification.

### **J.5.f. Trip Tests**

Interconnection Protective Functions and devices (e.g., reverse power relays) that have not previously been tested as part of the Interconnection Facilities with their associated interrupting devices (e.g., contactor or circuit breaker) shall be trip tested during commissioning. The trip test shall be adequate to prove that the associated interrupting devices open when the protective devices operate. Interlocking circuits between Protective Function devices or between interrupting devices shall be similarly tested unless they are part of a system that has been tested and approved during manufacturing.

### **J.5.g. In-service Tests**

Interconnection Protective Functions and devices that have not previously been tested as part of the Interconnection Facilities with their associated instrument transformers or that are wired in the field shall be given an in-service test during commissioning. This test will verify proper wiring, polarity, CT/PT ratios, and proper operation of the measuring circuits. The in-service test shall be made with the power system energized and carrying a known level of current. A measurement shall be made of the magnitude and phase angle of each Alternating Current (AC) voltage and current connected to the protective device and the results compared to expected values. For protective devices with built-in Metering Functions that report current and voltage magnitudes and phase angles, or magnitudes of current, voltage, and real and reactive power, the metered values may be used for in-service testing. Otherwise, portable ammeters, voltmeters, and phase-angle meters shall be used.

## **J.6. PERIODIC TESTING**

Periodic Testing of Interconnection-related Protective Functions shall be performed as specified by the manufacturer, or at least every four years. All periodic tests prescribed by the manufacturer shall be performed. The Producer shall maintain periodic test reports or a log for inspection by EC. Periodic Testing conforming to EC test intervals for the particular Line Section may be specified by EC under special circumstances, such as high fire hazard areas. Batteries used to activate any Protective Function shall be checked and logged once per month for proper voltage. Once every four years, these batteries must be replaced or a discharge test must be performed.

## **J.7. TYPE-TESTING PROCEDURES NOT DEFINED IN OTHER STANDARDS**

This section describes the additional Type Tests necessary to qualify a device as Certified under this Rule. These Type Tests are not contained in Underwriters Laboratories UL 1741

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Standard *Inverters, Converters and Controllers for Use in Independent Power Systems*, or other referenced standards.

### J.7.a. Non-Exporting Test Procedures

The Non-Exporting test is intended to verify the operation of relays, controllers and inverters designed to limit the export of power and certify the equipment as meeting the requirements of Screen 2, Options 1 and 2, of the review process. Tests are provided for discrete relay packages and for controllers and inverters with the intended Functions integrated.

#### 1) Discrete Reverse Power Relay Test

This version of the Non-Exporting test procedure is intended for discrete reverse power and under power relay packages provided to meet the requirements of Options 1 and 2 of Screen 2. It should be understood that in the reverse power application, the relay will provide a trip output with power flowing in the export (toward EC's Distribution System) direction.

##### *Step 1: Power Flow Test at Minimum, Midpoint and Maximum Pickup Level Settings*

Determine the corresponding secondary pickup current for the desired export power flow of 0.5 secondary watts (the minimum pickup setting, assumes 5 Amps and 120V CT/PT secondary). Apply nominal voltage with minimum current setting at zero (0) degrees phase angle in the trip direction. Increase the current to pickup level. Observe the relay's (LCD or computer display) indication of power values. Note the indicated power level at which the relay trips. The power indication should be within 2% of the expected power. For relays with adjustable settings, repeat this test at the midpoint, and maximum settings. Repeat at phase angles of 90, 180 and 270 degrees and verify that the relay does not operate (measured watts will be zero or negative).

##### *Step 2: Leading Power Factor Test*

Apply rated voltage with a minimum pickup current setting (calculated value for system application) and apply a leading power factor load current in the non-trip direction (current lagging voltage by 135 degrees). Increase the current to relay rated current and verify that the relay does not operate. For relay's with adjustable settings, this test should be repeated at the minimum, midpoint and maximum settings.

##### *Step 3: Minimum Power Factor Test*

At nominal voltage and with the minimum pickup (or ranges) determined in Step 1, adjust the current phase angle to 84 or 276 degrees. Increase the current level to pickup (about 10 times higher than at 0 degrees) and verify that the relay operates. Repeat for phase angles of 90, 180 and 270 degrees and verify that the relay does not operate.

##### *Step 4: Negative Sequence Voltage Test*

Using the pickup settings determined in Step 1, apply rated relay voltage and current at 180 degrees from tripping direction, to simulate normal load conditions

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(for three-phase relays, use Ia at 180, Ib at 60 and Ic at 300 degrees). Remove phase 1 voltage and observe that the relay does not operate. Repeat for phases 2 and 3.

### *Step 5: Load Current Test*

Using the pickup settings determined in Step 1, apply rated voltage and current at 180 degrees from the tripping direction, to simulate normal load conditions (use Ia at 180, Ib at 300 and Ic at 60 degrees). Observe that the relay does not operate.

### *Step 6: Unbalanced Fault Test*

Using the pickup settings determined in Step 1, apply rated voltage and two times rated current, to simulate an unbalanced fault in the non-trip direction (use Va at 0 degrees, Vb and Vc at 180 degrees, Ia at 180 degrees, Ib at 0 degrees, and Ic at 180 degrees). Observe that the relay, especially single phase, does operate properly.

### *Step 7: Time Delay Settings Test*

Apply Step 1 settings and set time delay to minimum setting. Adjust the current source to the appropriate level to determine operating time, and compare against calculated values. Verify that the timer stops when the relay trips. Repeat at midpoint and maximum delay settings.

### *Step 8: Dielectric Test*

Perform the test described in IEC 414 using 2 kV RMS for one minute.

### *Step 9: Surge Withstand Test*

Perform the surge withstand test described in IEEE C37.90.1.1989 or the surge withstand capability test described in Section J.3.e.

## **2) Discrete Under-Power Relay Test**

This version of the Non-Exporting test procedure is intended for discrete under-power relay packages and meets the requirements of Option 2 of Screen 2. A trip output will be provided when import power (toward the Producer's Load) drops below the specified level.

Note: For an under-power relay, pickup is defined as the highest power level at which the relay indicates that the power is less than the set level.

### *Step 1: Power Flow Test at Minimum, Midpoint and Maximum Pickup Level Settings*

Determine the corresponding secondary pickup current for the desired power flow pickup level of 5% of peak load minimum pickup setting). Apply rated voltage and current 0 (zero) degrees phase angle in the direction of normal load current.

Decrease the current to pickup level. Observe the relay's (LCD or computer display) indication of power values. Note the indicated power level at which the relay trips. The power indication should be within 2% of the expected power. For

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relays with adjustable settings, repeat the test at the midpoint and maximum settings. Repeat at phase angles of 90, 180 and 270 degrees and verify that the relay operates (measured watts will be zero or negative).

### *Step 2: Leading Power Factor Test*

Using the pickup current setting determined in Step 1, apply rated voltage and rated leading power factor load current in the normal load direction (current leading voltage by 45 degrees). Decrease the current to 145 percent of the pickup level determined in Step 1 and verify that the relay does not operate. For relays with adjustable settings, repeat the test at the minimum, midpoint and maximum settings.

### *Step 3: Minimum Power Factor Test*

At nominal voltage and with the minimum pickup (or ranges) determined in Step 1, adjust the current phase angle to 84 or 276 degrees. Decrease the current level to pickup (about 10 percent of the value at 0 degrees) and verify that the relay operates. Repeat for phase angles 90, 180 and 270 degrees and verify that the relay operates for any current less than rated current.

### *Step 4: Negative Sequence Voltage Test*

Using the pickup settings determined in Step 1, apply rated relay voltage and 25 percent of rated current in the normal load direction, to simulate light load conditions. Remove Phase 1 voltage and observe that the relay does not operate. Repeat for Phases 2 and 3.

### *Step 5: Unbalanced Fault Test*

Using the pickup settings determined in Step 1, apply rated voltage and two times rated current, to simulate an unbalanced fault in the normal load direction (use  $V_a$  at 0 degrees,  $V_b$  and  $V_c$  at 180 degrees,  $I_a$  at 0 degrees,  $I_b$  at 180 degrees, and  $I_c$  at 0 degrees). Observe that the relay, especially single phase types, operates properly.

### *Step 6: Time Delay Settings Test*

Apply Step 1 settings and set time delay to minimum setting. Adjust the current source to the appropriate level to determine operating time and compare against calculated values. Verify that the timer stops when the relay trips. Repeat at midpoint and maximum delay settings.

### *Step 7: Dielectric Test*

Perform the test described in IEC 414 using 2 kV RMS for one minute.

### *Step 8: Surge Withstand*

Perform the surge withstand test described in IEEE C37.90.1.1989 or the surge withstand test described in Section J.3.e.

## **3) Tests for Inverters and Controllers with Integrated Functions**

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Inverters and controllers designed to provide reverse or under-power Functions shall be tested to certify the intended operation of this function. Two methods are acceptable:

Method 1: If the inverter or controller utilizes external current/voltage measurement to determine the reverse or under-power condition, then the inverter or controller shall be functionally tested by application of appropriate secondary currents and potentials as described in the Discrete Reverse Power Relay Test, Section J.7.a.(1) of this Rule.

Method 2: If external secondary current or voltage signals are not used, then unit-specific tests must be conducted to verify that power cannot be exported across the PCC for a period exceeding two seconds. These may be factory tests, if the measurement and control points are integral to the unit, or they may be performed in the field.

### **J.7.b. In-rush Current Tests Procedures**

This test will determine the maximum In-rush Current drawn by the Generator.

#### **1) Locked-Rotor Method**

Use the test procedure defined in NEMA MG-1 (manufacturer's data is acceptable if available).

#### **2) Start-Up Method**

Install and setup the Generating Facility equipment as specified by the manufacturer. Using a calibrated oscilloscope or data acquisition equipment with appropriate speed and accuracy, measure the current draw at the Point of Interconnection as the Generating Facility starts up and parallels with EC's Distribution System. Startup shall follow the normal, manufacturer-specified procedure. Sufficient time and current resolution and accuracy shall be used to capture the maximum current draw within five percent. In-rush Current is defined as the maximum current draw from EC during the startup process, using a 10-cycle moving average. During the test, the utility source, real or simulated, must be capable of maintaining voltage within +/- 5% of rated at the connection to the unit under test. Repeat this test five times. Report the highest 10-cycle current as the In-rush Current. A graphical representation of the time-current characteristic along with the certified In-rush Current must be included in the test report and made available to EC.